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History

From above or below: The controversy and historical evolution of tuberculum sellae meningioma resection from open to endoscopic skull base approaches

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ABSTRACT

In the early 20th century, the first successful surgical removal of a tuberculum sellae meningioma (TSM) was performed and described by Harvey Cushing. It soon became recognized that TSM pose a formidable challenge for skull base surgeons because of their deep and sensitive location, proximity to critical neurovascular elements, and often dense and fibrous nature. Because of this, over the next several decades controversy transpired regarding their optimal method of resection. Early attempts involved utilization of open transcranial routes. This included classic bilateral and unilateral frontal approaches, followed by pterional or frontotemporal approaches, which have evolved to incorporate skull base modifications, such as the supraorbital, orbitozygomatic, and orbitopterional approaches. Minimally invasive supraorbital keyhole approaches through eyebrow incisions have also been adopted. Over the past 25 years, the microsurgical transsphenoidal approach, classically used for pituitary and parasellar tumors, was modified to resect suprasesllar TSM via the extended transsphenoidal approach. More recently, with the evolution of endoscopic techniques, resection of TSM has been achieved using purely endoscopic endonasal transplanum transtuberculum approaches. Although each of these techniques has been successfully described for the treatment of TSM, the question still remains: is it better to access and operate on these lesions via a traditional, transcranial avenue, or are they better treated via endoscopic endonasal techniques? We outline the surgical management of TSM through history, from early transcranial and transsphenoidal approaches to modern extended endoscopic endonasal procedures. We briefly explore the arguments favoring each of the methods and the advancements which have emerged to further optimize surgical resection.

1. Introduction

A substantial body of literature has been devoted to depict the distinct characteristics and clinical manifestations of tuberculum sellae meningiomas (TSM). TSM were first described in the latter half of the 19th century by James Stewart [1]. Since this initial description, the literature has become particularly heterogeneous over time due to variations in nomenclature, classification, and operative management. Nevertheless, it is well recognized that TSM encompass roughly 5–10% of all intracranial meningiomas [2–7], and are notorious for causing mass effect upon adjacent neurovascular structures, particularly the optic nerves and chiasm [8].

TSM pose a formidable surgical challenge for skull base surgeons because of their sensitive location and their often dense, fibrous nature [9,10]. These challenges have resulted in nearly a century of controversy regarding the optimal method for their surgical removal. Early surgical attempts utilized classic transcranial approaches. The first surgical removal of a TSM was performed in 1916 by Harvey Cushing via a unilateral, subfrontal approach with favorable results (Figs. 1, 2) [11]. The use of the pterional (frontotemporal) approaches was soon favored [12–17], but TSM resection has since evolved to incorporate modified skull base techniques, such as the supraorbital [12,18–22], orbitozygomatic [22–26], and orbitopterional approaches [24,27–29]. In addition, newer, minimally invasive supraorbital keyhole approaches through eyebrow incisions have also been described for these

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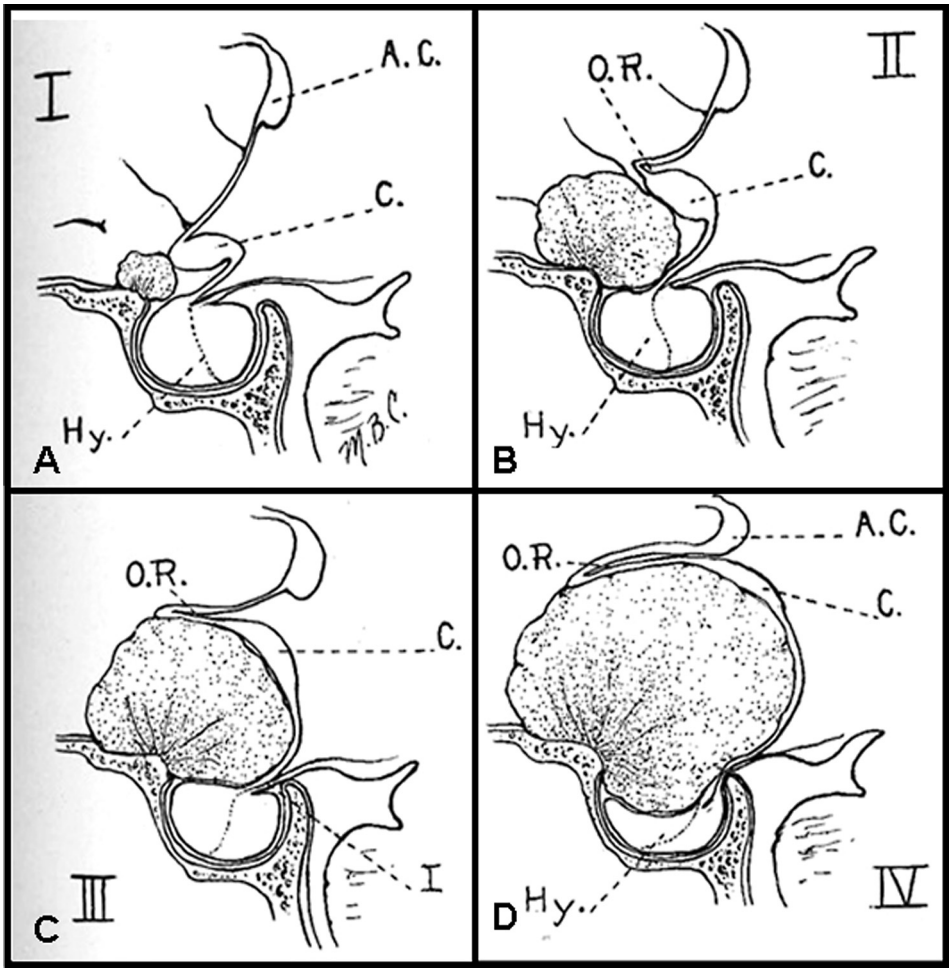

Fig. 1. Sketches in sagittal section depicting Harvey Cushing's staging of suprasellar meningiomas based on the "deformation of the [optic] chiasm and third ventricle." Stage I: presymptomatic (A), Stage II: surgically favorable (B), Stage III: early, surgical unfavorable (C), and Stage IV: late, surgical unfavorable (D). Reproduced from Cushing H, Eisenhardt L. Meningiomas arising from the tuberculum sellae, with syndrome of primary optic atrophy and bitemporal field defects combined with normal sella turcica in middle-aged person. *Archives of Ophthalmology.* 1929;1(1):1–41, 168–206, with permission. AC = anterior commisure, C = chiasm, Hy = hypophysis, I = infundibulum, OR = optic recess.

tumors [12,18–20,30]. Over the past 25 years, the microsurgical transsphenoidal approach, classically used for pituitary and parasellar tumors, has been utilized to resect TSM via the extended transsphenoidal approach [8,31–36]. In more recent years, with the advent of the surgical endoscope and development of multidisciplinary skull base teams, resection of these lesions has been achieved using purely endoscopic endonasal transplanum transtuberculum approaches [5,6,35,37–42].

Historically, it has been clear that regardless of the surgical approach chosen, the primary treatment objectives for TSM have remained the same: gross total tumor resection with adequate decompression of the optic apparatus, improved or preserved visual function, and prevention of future recurrence. In light of these goals, a question asked by Cushing nearly a century ago still remains today:

> "What is the best method of exposure? . . . What shall be done with the lesion when it is brought to view? Though the latter is by far the most important consideration, it is to the former that most attention in the beginning is usually paid. The pioneers blaze various trails into a new country; their followers . . . instinctively take the shortest and safest route." [1] – Harvey Cushing, 1929

More specifically, we ask ourselves: Is it better to access and operate on these lesions via a traditional, transcranial route, or are they better treated via minimally invasive endoscopic techniques? We outline the surgical management of TSM through history, from the early use of open transcranial and transsphenoidal techniques to the modern use of extended endoscopic endonasal procedures. We also briefly explore the arguments favoring the methods and advancements that have emerged for optimizing surgical resection.

2. Early practices: Use of open transcranial approaches

The first patient with a presumed TSM was discovered incidentally at an autopsy and described by James Stewart in 1899 [11,43]. Soon after, additional patients were briefly described by Archibald in 1908, Heinrichsdorff in 1914, and Livierato and Cosmettatos in 1916 [11]. Most of the reported patients leading up to the 1920s had been too far advanced for adequate operative intervention, and the precise location of these tumors remained undetermined [1,11]. The first successful removal of a TSM in its entirety was performed in 1916 by Cushing via a unilateral, subfrontal approach in a 38-year-old man. However, it was not until Cushing encountered similar lesions and published his findings in 1929 that these tumors appeared to arise from the tuberculum sellae and sulcus chiasmatis [1]. After that, Cushing made several advances regarding the understanding of these once perplexing lesions. In the 1930s, he applied the term "chiasmal syndrome," first described by Holmes and Sergeant in 1927 [44], to describe the symptoms produced by suprasellar meningiomas, such as TSM. The "chiasmal